Thales and Anaxagoras, the speculations of Leibnitz, De Maillet, Wright, Lambert, Herschel, and La Place. Of Buffon he says:—

> "Buffon was the naturalist of the day in the time of Louis XV. and Louis XVI.,—a period somewhat famous for the restrictions which were placed upon men, and the denunciations with which new and advanced ideas were received. Thus advanced thinkers found that their theories in many instances, instead of leading them on to fame, but opened the doors of the Bastile.
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> "It is not improbable that Buffon was in accord with the feeling of the time, as while his great discursive work—'Histoire Naturelle,' of 1749-88—fully outlines the theory of evolution, in which he was a believer, it is done in an ironical, partly satirical manner, so that he could, if attacked, retreat by claiming that it was a satire on the advanced scientific thought of the time; . . . he was ready to believe that from a single unit in the beginning might have descended all the various forms of existing animal and plant life. It is curious to note that this pioneer evolutionist suddenly corrects himself and says: 'But no; it is certain from revelation that every species was directly created by a separate fiat.' We may suspect that this secession from a position so broadly taken was forced upon the evolutionist. Perhaps the clergy gave him close and suggestive attention, and he was offered the choice between the Bastile, the Sorbonne, and apology to offended orthodoxy. Be this as it may, Buffon was one of the early delineators of the modern theory of evolution, and despite his peculiar attitude, history accords him this recognition."

The works of Wolff, of Goethe, Geoffroy St. Hilaire Oken, Pander, Von Baer, Schleiden and Schwann, Von Mohl and Max Schultze, Lord Monboddo and Erasmus Darwin, are all referred to in due order; and a well-bestowed paragraph of praise is given to Lamarck. Later writers, such as Robert Chambers, Von Humboldt, Owen, Asa Gray, Herbert Spencer, and Youmans, bring us down to the birth of modern Darwinism.

To English readers the last (twentieth, but erroneously headed eighteenth) chapter will be one of the most interesting. It is entitled "The Darwin Memorial," and contains a series of addresses by American men of science, delivered at a special memorial meeting of the Biological Society of Washington soon after the death of the illustrious naturalist in 1882. The address of Dr. Theodore Gill, of the Smithsonian Institution, is a masterpiece of eloquence, treating of "The Doctrine of Darwin," and contrasting the doctrines of special creation and evolution. The address by William Dall, of the United States National Museum, is equally eloquent, and treats of Darwin in the form of a biographical sketch. Dr. John Powell, the Director of the United States Geological Survey, follows with an admirable address on "Darwin's Contributions to Philosophy." We cannot refrain from transcribing some of his remarks:—

> "But Darwin's investigations have not ended research or completed philosophy. He brought scientific men to the frontiers of truth, and showed them a path across the border. Yet more than this he did. He pointed out one of the fundamental methods of research. Before his time philosophers talked about deductive methods and inductive methods. Darwin has taught us that both are fruitless. . . . By inductive methods, men are to collect facts, unbiased by opinions or preconceived theories. They are to gather the facts, put them together, arrange and combine them to find higher and still higher generalizations. But there are facts and facts—facts with value, and facts without value. The indiscriminate gathering of facts leads to no important discoveries. Men might devote themselves to counting the leaves on the trees, the blades of grass in the meadows, the grains of sand on the sea-shore; they might weigh each one and measure each one, and go on collecting such facts until libraries were filled and the minds of men buried under their weight, and no addition would be made to philosophy thereby. There must be some method of selecting, some method of determining what facts are valuable and what facts are trivial. The fool *collects* facts; the wise man *selects* them. Amid the multiplicity of facts in the universe, how does the wise man choose for his use? The true scientific man walks not at random through the world, making notes of what he sees; he chooses some narrow field of investigation; . . . his investigations are always suggested by some hypothesis—some supposition of what he may discover. He may find that his hypothesis is wrong, and discover something else; but without an hypothesis he discovers nothing. . . . Working hypotheses are the instruments with which scientific men select facts. By them, reason and imagination are conjoined, and all the powers of the mind employed in research."

The succeeding address, by Dr. C. V. Riley, gives an account of Darwin's entomological work, and comprises a graphic description of the naturalist in his home, drawn from personal reminiscences of a visit to Down. Dr. Lester Ward follows with his address on "Darwin as a Botanist," in the course of which he discusses, among other points, the bearing of Darwin's researches on the power of movement in plants on the great question wrapped up in the expression "tendency to vary." Dr. Frank Baker contributes the next address, on the expression of the emotions, and in this we again meet with a spirited advocacy of the Darwinian method:—

> "But not as a fact-gatherer do we find him greatest. Many others have struggled with ant-like toil to amass piles of facts, which, like the ant-heap, remain but sand after all. Darwin brings to his work an informing spirit, the genius of scientific hypothesis. Breathed upon by this spirit, the dry bones of fact come together 'bone to his bone,' the sinews and the flesh come upon them, they become alive and stand upon their feet, 'an exceeding great army.' He searches always for the principles which underlie the facts and make them possible, realizing that the *phenomena*, the things which are seen, are temporal and transitory; the things which are not seen, the cosmical forces which govern and control, are eternal."

A Darwinian bibliography, by Frederick W. True, the Librarian of the United States National Museum, and an appendix giving a list of Darwin's works, conclude a volume of which enough has been said to commend it to all readers, whether youthful or adult, and which we on this side of the Atlantic cannot but appreciate as a most inspiriting picture of the life and work of the man who, of all others, has helped to emblazon our country's fame on the scientific scroll of the nineteenth century.

R. MELDOLA.

PINES AND FIRS OF JAPAN.

Monographie der Abietineen des Japanischen Reiches. Bearbeitet von Dr. Heinrich Mayr. Mit 7 Colorirten Tafeln. (Munchen: M. Nieger'sche Universitäts Buchhandlung, 1890.)

FROM the time of Kaempfer and that of Thunberg to our own day, the Japanese Conifers have been the objects of special predilection on the part of botanists.

Zuccarini figured and described several that had been collected by Siebold, Lindley, Andrew Murray, Maximowicz, Franchet, and others, contributed greatly to the elucidation and delimitation of the several species. Robert Fortune, John Gould Veitch, and Charles Maries introduced many to our gardens. Horticulture has, indeed, rendered great service in this matter. The trees in question are valuable for ornamental purposes, and potentially as timber trees. The consequence of this is that collectors have accumulated specimens in large numbers and in different stages of growth. They have, moreover, supplied our nurserymen with seed, so that young plants are now numerous in our nurseries and plantations.

The study of the seedling plants, in their progress from the seed-bed towards maturity, has afforded valuable evidence concerning the morphology of the group and its probable genealogy, its filiation and classification. Cultivation has, for instance, shown that many of the very curious forms known under the name of Retinospora are, in reality, stages of growth of one, or at least of a few, species of Thuya, of Cupressus, or of Juniperus, so that the so-called genus is purely fictitious. In like manner *Abies bifida* and *Abies firma* have been proved to belong to one and the same species.

To fill up the gaps in our knowledge, and to correct errors arising from inadequate or imperfect material, it was necessary that the trees should be studied by a trained observer in the forests themselves. This was the more necessary as, to a large extent, our knowledge has been derived from plants cultivated by the Japanese and, in some cases, not a little distorted in the process. The earlier botanists had little or no opportunities of studying the native flora for themselves. Even Fortune was largely dependent on the Japanese nurserymen. John Veitch collected for himself on Fusi-yama, and Maries penetrated even to the forests of Yesso. Dr. Mayr, the latest writer on these plants, has enjoyed opportunities denied to his predecessors. After a distinguished career in Munich, Dr. Mayr proceeded to the United States, visiting the forests in all parts of the Union, and producing, as a result, a work which the best judges speak of in terms of high appreciation. Subsequently, our author visited Japan to organize the Forest Department, and fill the office of Professor of Forestry in the Imperial University of Tokio. In the execution of his duties Dr. Mayr travelled through the various provinces, and derived much information from the native foresters. One result is before us in the shape of a volume, printed in German at Tokio, and illustrated with seven coloured plates. The group specially studied by Dr. Mayr is remarkable for the relatively large number of endemic species. Thus, Dr. Mayr enumerates six species of Abies, all of which are peculiar to the Japanese islands. Five species of Picea are nearly as much restricted in geographical area. Tsuga, a genus represented in both the North-eastern and the North-western States of America, as well as in the Himalayas, has two species peculiar to Japan. The genus Larix, which also has a wide distribution in the northern hemisphere, has two species native to Japan, and not extending far beyond its limits. Six species of Pinus are enumerated by Dr. Mayr, and these also are almost exclusively Japanese, though some are found on the mainland adjoining.

The Japanese islands, then, form a centre of distribution of a group of species of a distinct character, differing markedly from a similar group of Chinese nativity, but approximating to the Californian and to the East American coniferous floras, and having representatives in other parts of Northern Asia and of Europe. The distinct character of the Japanese Coniferæ and their relationships are even more prominently brought into view when the other tribes of Conifers are considered. Dr. Mayr confines himself, however, to the Abietineæ, and we must here follow his example, in the hope that on another occasion we may be able to accompany him also through the other tribes.

In speaking of the distribution of these plants, Dr. Mayr alludes (1) to the tropical zone in which the genus Podocarpus is represented, but which does not specially concern us now; (2) to a sub-tropical zone in which are other two species of Podocarpus, as well as *Pinus Thunbergii*, which extends round the coast of all the islands, and less frequently *Pinus densiflora;* (3) a region of deciduous trees, such as chestnuts in the south or at the base of the mountains, or beeches and birches to the northward or at higher altitudes. Here grow especially the Cryptomeria, the various species of Chamæcyparis, Thuyopsis, and Sciadopitys. (4) The fourth zone, that of firs and spruces, occupies the high mountains in the centre of the island. Here are found *Abies Veitchii*, *Picea bicolor*, *P. Hondoensis*, and *Larix leptolepis*, which are peculiar to the main island, together with *A. Mariesi*, *A. sachalinensis*, *Picea ajanensis*, and *P. Glehni*, which extend northward, some even as far as the Sachalin and Kurile Islands. *Tsuga diversifolia* occurs from the region of the beech upwards to the Alpine zone. (5) The fifth, or Alpine region, also designated that of the Alpine pines, includes forms such as *Pinus pumila*, which is allied to the Swiss *P. Cembra.* We can only indicate these regions, as the discussion of their climatal features and plant population turns mainly upon plants different from those which form the staple of Dr. Mayr's present treatise.

Passing into detail, Dr. Mayr proceeds to describe each species separately, devoting much space to literary references, Japanese as well as European, and giving a description of the main peculiarities of the tree from an economic as well as from a botanical aspect.

A few new species are indicated, of the value of which we can hardly form a trustworthy opinion in the absence of authentic specimens. We venture, however, to doubt whether *Abies homolepis* is, as, however, others besides Dr. Mayr think, identical with *A. brachyphylla*. The leaf structure of the two is certainly different, and cultivation may yet reveal other differences. The names *bicolor*, *Alcockiana*, *ajanensis*, *jessoensis*, *japonica*, *microsperma*, as applied to one or more species of Picea, have been so variously understood by botanists, owing partly to accidental misplacement of labels, admixture of seeds, and to imperfect information, that it is very important to have an authoritative statement from such an observer as Dr. Mayr. If allowances be made for a large amount of variability within the conventional specific limitations, it would seem from the figure as if Dr. Mayr's *Pinus pumila* might be referred to *P. Cembra*, whilst *P. pentaphylla* is obviously a near ally of the East American *P. strobus*.

Dr. Mayr's "diagnose," however, is really a rather diffuse description in German, not conveniently adapted for the comparison of one form with another. In this absence of concise comparisons in Latin, modern botanists, especially German ones, compare unfavourably with their predecessors. On the other hand, Dr. Mayr establishes some sectional characters which may prove useful, such as the three sections into which he divides the genus Picea, viz. Morinda, Casieta, and Omorica, the last, indeed, having been already proposed by Willkomm.

Hybrid forms between *Pinus Thunbergii* and *P. densiflora* are mentioned, as well as a whole series of garden varieties which have either originated in Japanese gardens or have occurred as "sports" on the wild trees, and which have been propagated by grafting by the Japanese gardeners. These are likely to prove of scientific interest, and will be specially interesting for garden purposes.

Seven quarto coloured lithographic plates accompany the volume, giving details of the foliage and cones. We could have wished that representations of the trees themselves could have been supplied, and that an alphabetical index of species and varieties had been added to the classified table of contents. When we have so much that is valuable and interesting presented to us, it may seem ungracious to hint at deficiencies, but really in this case to ask for more shows how greatly we appreciate what we have, and is about the greatest compliment we can pay to the author. MAXWELL T. MASTERS.

ELEMENTARY HYDROSTATICS.

Solutions of Examples in Elementary Hydrostatics. By W. H. Besant, Sc.D., F.R.S., Fellow of St. John's College, Cambridge. (Cambridge: Deighton, Bell, and Co., 1891.)

THIS is a collection of solutions, or a *crib*, to the author's well-known "Elementary Hydrostatics," which has held the ground in elementary instruction unchallenged since 1863.

It was cruel, though, as Dr. Besant apologetically explains, unavoidable, to keep the world of instructors waiting so long for these much-needed solutions and explanations of the questions in his Hydrostatics.

The Solutions are stated to be almost entirely drawn up by Mr. A. W. Flux, who has found it necessary to explain that the equation $p = g\rho z$ must be interpreted as giving the pressure p in *poundals per square foot* (or in C.G.S. *barads*, might well have been added); but he has not explained that the effect of this reverential interpretation is to make ρ and w signify the same thing; so that two symbols are used to denote the same quantity, although one, ρ, is called the *density*, and the other, w, the *intrinsic weight*.

But in 1863 the word *poundal* was not known, nor was any mode of measuring force and pressure in use, except in terms of gravitation units.

It would take too long to recount the despair of the instructor and the confusion of the student at the different modes of reconciliation of the equations $p = g\rho z$ and $p = wz$, variously used as measuring the pressure at a depth of z feet.

Because thirty and more years ago it was thought convenient in dynamical equations to replace W/g by a single letter M, merely for purposes of convenience in writing and printing, it was and is still taught in our theoretical treatises that the equation $W = Mg$ is the expression of a subtle and fundamental law of Nature, to be introduced even into a treatise on Elementary Hydrostatics, presumably taken up before a student has commenced Dynamics, and before he can understand what acceleration in general, and the particular acceleration g, can mean.

What must, for instance, be the feeling of Tommy Atkins, when the Musketry Instructor begins on p. 1 of the official "Treatise on Military Small Arms," 1888, with this definition of Mass, taken in a garbled form from chapter ii. of the Hydrostatics and elsewhere.

> "Mass: The *quantity of matter* in any body, the sum of all the particles of the body; it is proportional to the weight, whatever be the figure, or whether the bulk or magnitude be great or small; for the weight is equal to the mass multiplied by the force of gravity, or $W = Mg$, and the letters M and W are usually employed to denote the *mass* and *weight* respectively."

In short, this definition amounts to saying that *mass* is something we denote by the letter M, while *weight* is something we denote by the letter W; but we must always remember that $W = Mg$, where g is something unexplained, even when we measure mass in pounds and weight also in pounds; so that if g appears in one place, it will cancel again somewhere else, and not affect the ultimate numerical result.

But if, according to former instructions, we calculate the pressure from the equation $p = g\rho z$, we must notice that ρ, the density as defined in chapter ii., "Elementary Hydrostatics," is the weight in pounds of one-gth part of a cubic foot of the liquid, or $g\rho$ is the weight in pounds of one cubic foot of the liquid, so that $g\rho$ and w now measure the same quantity.

The unfortunate instructor was formerly called upon to reconcile these opposing statements, that w is sometimes the same as ρ, and sometimes as $g\rho$; now, however, he can take refuge behind the definite statements of this authorized collection of solutions.

But what is most wanted is a mathematical Censorship, to go through our hydrostatical treatises, expunging all the g's.

As to the mere mathematical geometrical part of the solutions, this is doubtless carried out with true Cambridge elegance, of which Dr. Besant is so well known an exponent; a trifle however, in comparison with the difficulty of the interpretation of the units in some extraordinary questions relating to the equations $W = sV$ and $W = g\rho V$, questions at one time considered a valuable test of clear thinking on the part of the student.

We counsel everyone who values his peace of mind to procure a copy of these Solutions, if called upon to interpret and expound the numerical results of the original "Elementary Hydrostatics."

A. G. GREENHILL.